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DETERMINING NECESSITY AND PRIORITY FOR TENDING IN YOUNG SPRUCE PLANTATIONS IN NORTHWESTERN ONTARIO

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INTRODUCTION

Vegetation management is an integral part of forest management. Non-crop vegetation often limits the survival and growth of young trees by reducing available light, moisture and nutrients. Proper timing and application of vegetation management treatments can make the difference between plantation success and failure.

The purpose of vegetation management is not to eliminate all competing plants but rather to direct more of the site's resources into usable forest products (Walstad 1988). Competition release programs should be aimed at the threshold where the negative impact of competitors on the survival and growth of crop trees is greater than the beneficial impact of these species on crop and site protection. Determining the threshold requires an understanding of the competitive effects of the various weed species.

BACKGROUND

The major competitors of spruce in northwestern Ontario are aspen (*Populus tremuloides* Michx.), alder (*Alnus crispa* Ait. and *Alnus rugosa* (Du Roi) Spreng.), mountain maple (*Acer spicatum* Lam.), hazel (*Corylus cornuta* Marsh.), willow (*Salix* spp.), sedges (*Carex* spp.) and grasses. The degree to which the growth of spruce suffers from competition depends on the type, density, and relative size of competitors. For example, dense low vegetation, such as bluejoint grass (*Calamagrostis canadensis* Marsh.), can cause severe competition for moisture and may cause mechanical damage by smothering seedlings. In contrast, a moderate cover of aspen provides protection from exposure and frost in the early years (Stiell 1976). Heavy aspen cover can cause severe competition for moisture and nutrients as well as mechanical damage.

The major problems facing establishing seedlings are: 1) competition for light; 2) competition for moisture; and 3) mechanical damage, such as smothering, whipping and browsing by small mammals. Spruce can survive and grow under light levels as low as 45 percent of full sun (Logan 1969). Thus, sites with vegetation that competes for light are a lower priority for release than sites with vegetation that competes for moisture or causes mechanical damage. It is often difficult to separate competition for light, moisture and nutrients since they are usually interrelated. Competition for moisture is more of a problem on dry sites where moisture is likely to be limited. Mechanical damage may be caused by the vegetation itself or by small mammals which use the vegetation for shelter.

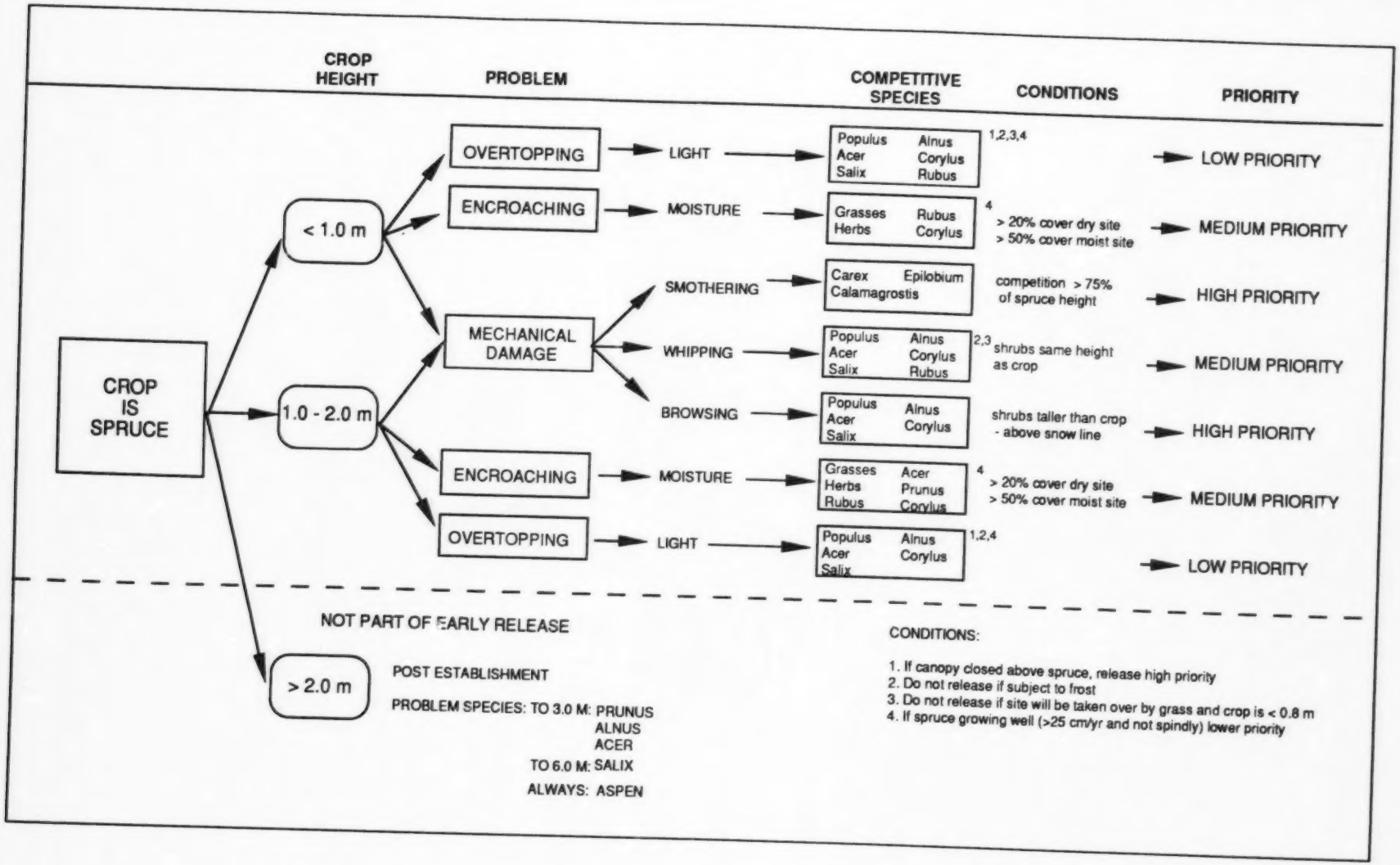

FIGURE 1: FLOW CHART FOR DETERMINING RELEASE NECESSITY AND PRIORITY FOR SPRUCE

A NEW APPROACH

The decision of when to implement a vegetation management program has, in the past, been based on visual assessments of the relative growth of crop tree and competitor species. A systematic approach employing a flow chart was developed for determining the need for release in spruce (*Picea* spp.) plantations.

Criteria used in the flow chart (Figure 1) are crop height, competitor species autecology and size, and type of competition or damage to which the crop tree is being subjected. Survival is the first priority, then growth. Survival and growth are considered as separate objectives because the cost of achieving levels of competing vegetation low enough to maintain survival is much less than the cost of managing vegetation for maximum growth (Wagner *et al.* 1989). Reduced survival delays regeneration and replanting requires additional investment; therefore, managing for survival is easier to justify than increased growth, even though the latter may be more desirable.

Indicator species associated with the various types of damage or competition are given as an aid to classifying the sites. Overtopping vegetation refers to anything taller than the crop tree which is overhanging or shading it resulting in reduced light availability or possible mechanical damage. Encroaching vegetation is equal in height or shorter than the crop tree and is competing for rooting space (thus reducing moisture and nutrient availability) or causing mechanical damage.

APPLICATIONS

The flow chart is applicable to spruce plantations from the time of establishment until the average height of the crop is 2.0 meters (m). After this, the crop trees become saplings and are considered free-to-grow. The chart can be used in conjunction with stocking, survival or free-to-grow surveys and should be used between mid-July and mid-August when vegetation development is at its peak. The only equipment requirements are a meter stick and a plant identification guide.

The procedure for using the flow chart in the field is as follows:

1) Determine the average height of crop trees in the plantation. If crop height is less than 1.0 m use top part of chart; if crop height is 1.0-2.0 m use the middle. Crops greater than 2.0 m in height are not considered part of early release, although competition may still be a problem.

2) Determine the major competing species on the site, and

3) Follow the flow chart to determine priority for release.

For example, if the average height of the crop is less than 1.0 m and the major competitor on the site is a heavy bladed grass, such as bluejoint, which is greater than 75 cm in height, the area would be high priority for release. Not only is the crop being subjected to competition for moisture during the growing season, decreasing potential growth, but it may also be smothered in the winter, thus decreasing survival.

If the major competing species are not obvious, it may be necessary to do a series of ten to twenty randomly located, crop tree centered 4 m^2 (1.13 m radius circular) plots. Normally, observation during survival or free-to-grow surveys will provide sufficient awareness of problem species. The species included in the flow chart are examples of major competitors of spruce in northwestern Ontario. For further information on the competitive mechanisms of these species, as well as those not included in the chart, refer to Bell (1991).

High priority plantations should be released in the year of assessment, medium priority by the following year and low priority can wait until time and/or funds are available, realizing that growth is being sacrificed and that priority will increase with time.

Although the flow chart may be used independently as a quick method of determining the need for release, allows for ranking sites according to priority for release, and provides competitor species awareness for treatment decisions, it has some drawbacks. It is not

quantitative and thus cannot be used for project documentation to measure the efficacy of treatments nor to relate pre- and post-treatment conditions on the site. Combining the flow chart with the competition index developed by Archibald and Towill (1989) is recommended for more thorough project documentation and to provide a means of assessing treatment efficacy, assuming treatments are applied. Once the spruce plantations within a management unit requiring release have been identified using the competition index, the flow chart can be used to identify priority plantations; or where to concentrate limited financial resources.

OTHER CONSIDERATIONS

There are a number of factors which need to be considered when undertaking a vegetation management program in spruce plantations. It is important to realize that the site will always tend towards 100% site occupancy or full utilization of the sites' resources. In vegetation management programs, it is all too common to remove one type of competition only to find it has been replaced with another which poses a more serious threat to establishing seedlings. For example, alder or aspen may be replaced by a thick mat of grass and raspberry when herbicide treatments are used. Grass is a much more serious competitor than aspen when seedlings are less than 1.2 m in height.

Crop tree height increment should be considered in borderline plantations. For example, if spruce growth is greater than 25 cm/year under shrubs and is not spindly, the priority may be lower than if it is only 5 cm/year. However, if the canopy is closed above the seedlings and has been for some time, the seedlings are likely adapted to low light conditions. They will have developed "shade leaves", which may result in sunscald on the needles when exposed by complete removal of the canopy. In these situations, a gradual reduction in the canopy such as is achieved with herbicides is often more effective than manual release.

The flowchart considers only biological factors. Priorities may also be influenced by management objectives for the site and operational concerns, such as distance from the mill, dollars invested on the site to date, etc. which have to be considered on a case by case basis.

For further background on vegetation dynamics and information on competition assessment methodologies refer to Buse and Towill (1991) and Archibald and Towill (1989).

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